STAT

20 January 1964
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ROTATING PRISM SCANNER

The rotating prism scanner is a device employing photoelectric setting on an image. Our attention was directed toward such a device as a potential aid in eliminating some of the subjective variation involved in RES measurements. It is claimed that the device substantially enhances the reproducibility in measurement of a given image by a given operator over "eyeball" techniques, and further, that the variation from operator to operator is substantially reduced.

Basically, the device operates as follows. Light passing through the film or plate containing the image of interest impinges on a beam splitter. Part of the light passes to a viewing screen, where the magnified image is displayed. The other portion of the light passes through a rotating prism to a slit, behind which a photomultiplier is located. The rotating prism causes the image of interest to be swept across the slit. The output of the photomultiplier is applied to the Y axis of an oscilloscope. A rotating sector or chopper is physically attached to the same shaft as the prism, so that perfect synchronization is achieved. The output of a photocell or photomultiplier, illuminated through the sector or chopper, is applied to the X axis of the oscilloscope. The configuration of the sector or chopper is such that the following sweep sequence results. As the scope is sweeping from left to right the transmittance of the line or edge under study is displayed from left to right. After a hold period the scope sweeps from right to left, displaying the same curve, but now in an opposite direction. The result is a display of the curve and its mirror image. For example, the display of a symmetrical image such as a spectral line, would appear as in Figure 1.

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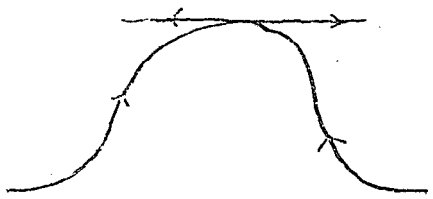
Figure 1.

An unsymmetrical image, such as an edge, might appear as in Figure 2.

Figure 2.



The two traces can be moved relative to each other by movement of the carriage supporting the plate or film. The precision of the device depends upon the sensitivity of the eye and brain to a symmetrical situation. For the spectral line in Figure 1, the position of the center of the line is read when the two curves coincide.

The measurement of the width of an edge is more complex. However, this width can and must be defined, and reproducible measurements obtained. For example, the height of the traces in Figure 2 can be brought to a standard value between two reference points by amplifier adjustment. Then the first reading might be taken when the two traces intersect at, say, 85% of maximum amplitude, as shown in Figure 3A. The final reading might be taken when the 85% amplitude point has been moved to the same abscissa as the previous 15% amplitude point, as in Figure 3B.

Figure 3A

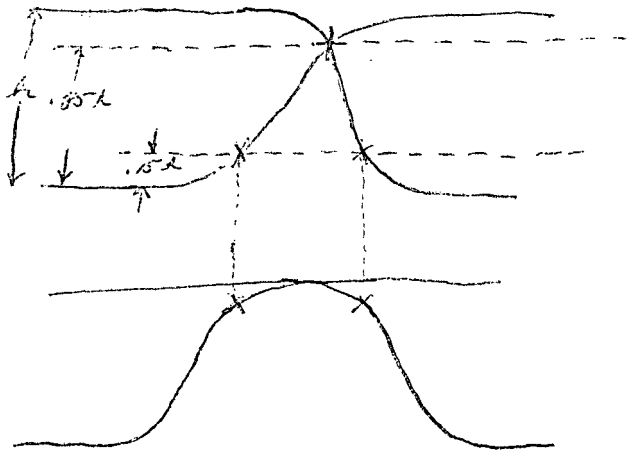


Fig 3B

~~Figure 3B~~

The edge width, as defined, is then the difference between the two readings.

It is apparent that such a technique allows reasonable reproducibility with a given edge for a given operator and also among several operators. The question that remains is the utility of such measurements on various edges. In this regard the choice of an optimum definition of the width of an edge deserves some study. It appears that the use of such a technique would lead to some improvement over strictly "eyeball" RES measurements, but the significance of the improvement is unknown.

Rotating prism scanners have been developed by at least two companies. These products are discussed below.

Grant Instruments - Spectrum Line Measuring Comparator

This device was developed principally for spectral line measurements. It is described in the attached brochure. Precision of 1 micron or better is

claimed for spectral measurements. The operation of the device was demonstrated by [redacted] of the Molecular Spectroscopy Section at the National Bureau of Standards to Messrs. [redacted] STAT of NPIC on 16 January 1964. The images of interest to the NBS personnel are symmetrical spectral lines, of the order of 20-25 microns width, on photographic plates. The NBS representatives are quite pleased with the equipment so far, and described it as well-made, reliable and flexible.

After seeing the equipment operate on spectral lines, a quick attempt was made to measure an edge on an unclassified aerial photographic transparency provided by [redacted] with poor results. It was evident that some care would be required to reset the machine, and that a different choice of scanning rate, amplifier setting, etc., would be required.

The basic price of this device is [redacted] STAT with available extras such as zoom lens, variable slit masks, digitized readout, etc., bringing the price to well over $20,000. The devices are custom-made with a delivery time of 4 months from date of order.

[redacted] - Type 999 Photoelectric Setting Device

The [redacted] STAT apparatus is described in the attached brochure. ~~IT IS NOT A~~ It is not a Production item and is currently not for sale.

The following information is based on a conversation between [redacted] of CIA on 4 December 1963.

At this time the equipment had been dismantled, and could not be seen in operation. A 2-dimensional version of the device underwent trial at the U. S. Coast and Geodetic Survey for the measurement of topographical images. Satisfactory operation was not obtained and the device was replaced. However, the STAT [redacted] representatives stated that good results had been obtained with 1-dimensional measurements of spectral lines, interference fringes, etc. Precision of about 1/2 micron is claimed. [redacted] STAT representatives hoped to test the devide on a typical edge in an aerial photographic image, after reassembly, but no results have been received to date.

Conclusions

If RES measurements are to be continued, the rotating prism scanner, should be seriously considered as a technique for removing some of the subjective variation previously involved. It is doubtful that such a technique could potentially replace the detailed microdensitometer edge trace operation described by STAT [redacted] Eastman Kodak Company. Both the [redacted] STAT devices appear to be quite flexible, and both manufacturers seem quite willing to discuss custom, special-purpose modifications. Conversation between interested parties and the manufacturers appear to be in order prior to any large additional investments in edge measuring equipment.